RESPONSES OF *MACRODACTYLUS* SPP. (COLEOPTERA: SCARABAEIDAE) AND OTHER INSECTS TO FOOD ATTRACTANT IN TLAXCALA AND JALISCO, MEXICO

HUGO CESAR ARREDONDO-BERNAL[1,3], JUAN CIBRIÁN-TOVAR[1] AND ROGER N. WILLIAMS[2]

[1]Centro de Entomología y Acarología Colegio de Postgraduados, 56230 Montecillo, Estado de México

[2]Department of Entomology Ohio Agricultural Research and Development Center The Ohio State University 1680 Madison Avenue, Wooster, OH 44691-4096

[3]Current address: Centro Nacional de Referencia de Control Biológico, Apartado Postal 133, Tecomán, Colima 28130, México

ABSTRACT

The effects of a food attractant [trinary mixture of hexanoic acid, valeric acid and octyl butyrate (1:1:1)] were evaluated in a trapping trial for scarab beetles in the Mexican states of Tlaxcala and Jalisco. This mixture was highly attractive to *Macrodactylus nigripes* Bates in Tlaxcala and *M. murinus* Bates in Jalisco, capturing a mean of 50.2 and 84 individuals per trap per sampling date, respectively. In addition, all other insects which were taken at the traps were identified to family and classified by feeding habits. Only one non-scarabeid species appeared to be attracted to the baited traps, i.e. *Apis mellifera* L.; all other insect families averaged less than one individual per trap.

Key Words: *Macrodactylus nigripes, M. murinus,* semiochemicals, trapping

RESUMEN

Se evaluó el efecto de un atrayente alimentario en la captura de escarabajos en los estados de Tlaxcala y Jalisco, México. El atrayente fue una mezcla de ácido hexanóico, ácido valérico y octil-butirato (1:1:1). Esta mezcla fue altamente atractiva para la captura *Macrodactylus nigripes* Bates en Tlaxcala (un promedio de 50.2 individuos por trampa por muestreo) y para *M. murinus* Bates en Jalisco (un promedio de 84 individuos por trampa por muestreo). Otros insectos capturados fueron identificados a nivel de familia y clasificados de acuerdo a sus hábitos alimentarios; el efecto del atrayente alimentario sobre estas poblaciones fue selectivo.

There are at least 28 known species in the genus *Macrodactylus*, all from the Nearctic region. The 20 species of *Macrodactylus* from Mexico are known as "frailecillos," "taches," or "burros" and feed on a wide variety of cultivated and wild plants (Morón & Terrón 1988). The larvae (grubs) are strictly root feeders. However, the adult stage causes damage to leaves, flower buds and fruits of many cultivated plants (Morón & Terrón 1988; Williams et al. 1990).

In Huamantla, Tlaxcala, and Manantlán, Jalisco, the adults of *Macrodactylus nigripes* Bates and *M. murinus* Bates are important pests of maize (Altieri & Trujillo 1987). The adults emerge after the first rains and appear to be synchronized with the

development of the maize crop. *Macrodactylus* spp. consume the pollen in the tassels, thereby reducing pollination. When the infestation is heavy, the beetles also consume the silks (styles), preventing pollination, and thus prohibiting the formation of grain. Insecticides have been widely utilized against this group of insects in Mexico. However, in the Manantlán Biosphere Reserve where pesticides are prohibited, we are searching for an alternate means for control which would be sustainable and environmentally sound.

Many studies have been carried out to determine efficacy of food attractants, e.g., for Japanese beetle, *Popillia japonica* Newman (Fleming 1969). For *Macrodactylus*, the first report of luring adult beetles to feeding attractants was mentioned by Johnson (1940), who collected *Macrodactylus* species at baits designed for Japanese beetles. In 1982, Williams & Miller determined that various aromatic compounds were attractive to adults of *Macrodactylus subspinosus* (F.) in Ohio and that hexanoic acid and valeric acid were the best attractants. Later Williams et al. (1990) conducted a study in which they evaluated more than 60 compounds with the objective of finding the best attractant for monitoring populations of *M. subspinosus*. The results of these studies showed that the mixture of valeric acid, hexanoic acid, and octyl butyrate, in the ratio of 1:1:1 exhibited the best attraction. In Chapingo, Cibrián et al. (1990) observed that this mixture was attractive to *M. mexicanus* Burmeister and various other insects. At the same time, they determined that trap color did not influence the capture of *M. mexicanus*. The objective of the present study was to determine the effects of this same food attractant on the capture of *M. nigripes*, *M. murinus*, and other insect taxa in Huamantla, Tlaxcala, and Manantlán, Jalisco.

Materials and Methods

The attraction of the test mixture on *M. nigripes* in Huamantla, Tlaxcala, was determined with 48 Yellow Super Traps (Reuter Laboratories, Manassas VA) placed in a field of maize known to be infested during the previous seasons. The traps were evenly distributed in an area of the field 0.5 ha in size. The objective was to measure the total capture of "frailecillos" per week. The first captures were based on collections of 16 traps.

At the second location, Manantlán, Jalisco, 36 traps were utilized to determine numbers of *Macrodactylus murinus* caught each fortnight. Traps were distributed uniformly in a maize field which was 0.375 ha in area. At the time the traps were set, the maize was in early florescence.

The traps were hung from galvanized pipes at approximately 1 m above the soil surface. A plastic bag attached to the bottom of each trap served as a receptacle to collect the beetles. Each bag was perforated with tiny holes near the bottom to avoid water accumulation during the rainy season, thus partially avoiding biological decomposition in the bags. Five ml of the volatile mixture of valeric acid, hexanoic acid and octyl butyrate were deposited in small green containers (Loral Poly-Cons) described in Klein & Edwards (1989). These containers were placed in the traps with their openings downward in order to avoid dilution of the attractant by rain or decomposition by direct sunlight.

At the same time, the effect of the trap density (4 or 8 = 64 or 128 per ha) on the capture of *M. nigripes* was determined in 1/16 ha plots in Huamantla, Tlaxcala. Each treatment was replicated four times using randomized blocks. With these parameters, we were able to measure the number of insects captured per trap. Means were compared by t test.

The effect of these attractants on other groups of insects was determined in Tlaxcala by recording the number of captures per trap per week. In Jalisco, the captures were recorded fortnightly. The identification of the majority of insects was made to family and, in some cases, to species.

Results and Discussion

In Huamantla, Tlaxcala, 5,832 *M. nigripes* were collected in 48 traps over a 10 week period. Based on trap captures, the maximum adult response at this location was from July 4 to July 15 (2,295 beetles). Collections decreased after that until the end of the season. However, there was an irregular pattern the week of July 30 - August 6, which was lower than the two adjacent weeks. After September 10, no more beetles were caught (Fig. 1). The differences in the numbers of specimens captured in the week of August 6-13 perhaps was due to a dry period followed by rain which stimulated adult emergence. In some parts of Mexico, adults are active for approximately a four-month period. In Chapingo, Mexico, studies conducted by Cibrián et al. (1990) showed that the capture of *M. mexicanus* is similar to that of *M. nigripes* in Huamantla, Tlaxcala.

In Manantlán, Jalisco, where 36 traps were set, the capture of *M. murinus* over the entire collecting period was 12,102 beetles. The maximum capture was between September 18 and October 2, with 10,613 beetles captured for the period. During the next fortnight, collections decreased by 93% to only 470 beetles. After October 30, no *M. murinus* adults were collected, indicating the end of the adult activity period (Fig. 2).

An average of 50 specimens of *M. nigripes* were captured per trap over the entire experiment, while 84 *M. murinus* were captured per trap. These figures are low com-

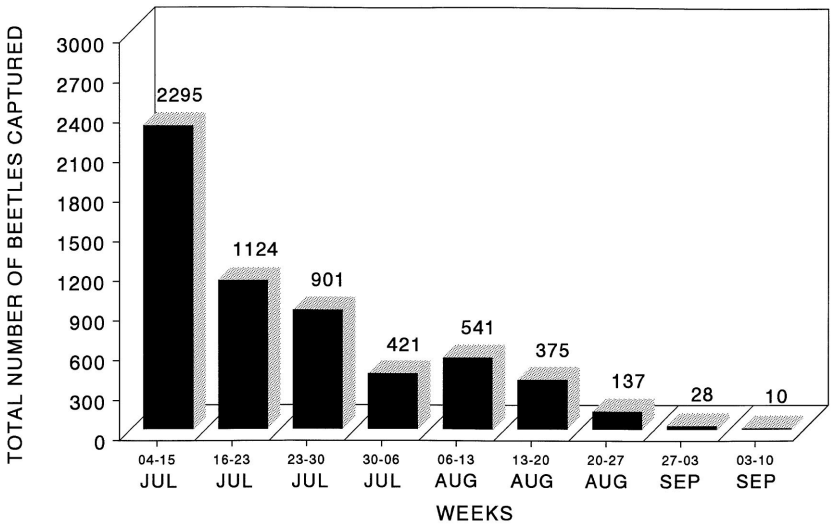

FIG. 1

Fig. 1. Trapping of *Macrodactylus nigripes* Bates with a food attractant in 48 yellow traps, Huamantla, Tlaxcala, Mexico, 1990.

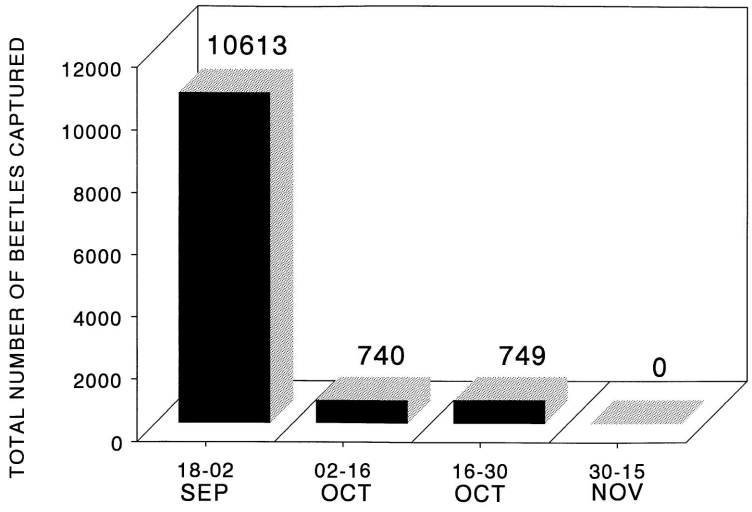

FIG. 2

Fig. 2. Capture of *Macrodactylus murinus* Bates with a food lure in 36 yellow traps, Manantlán, Jalisco, Mexico, 1990. (Fortnightly)

pared to those reported by Williams et al. (1990) with the same attractant in Ohio where 125 *M. subspinosus* were captured per trap. Of course, these collections can not be directly compared but are mentioned here as a reference to the abundance of *Macrodactylus* spp. when present. Here, we are dealing with different species, thus trap catches may reflect the degree of efficacy in response to attractant rather than population density.

Because maize was the major host being considered in this study, it would seem that *Macrodactylus* spp. may have built up to higher numbers due to the extended flowering period in which the maize plant is vulnerable. The flowering period of maize is locally extensive because the maize is planted over an elevation gradient of more than 500 m and the maize flowers at different times, depending upon the elevation.

Having studied the collection and behavior of the populations, it was determined that the use of feeding attractants is a viable option for monitoring *Macrodactylus* adult activity. However, when the traps and attractants are used experimentally, it is necessary to correlate the number of insects captured with the density required to cause damage (economic threshold). This information might aid in a better understanding of the degree of protection offered by trapping the beetles.

The capture of beetles using two different trap densities was compared on populations of *M. nigripes* in parcels of 1/16 ha. It was determined that the higher density of traps captured significantly ($t = 3.77$, $P = 0.05$) greater numbers of beetles. Fig. 3 shows the differences in the numbers of beetles which were captured on different dates of the experiment. Effects of trap densities were observed on local populations of *Macrodactylus* spp. where correlated studies were conducted with differing numbers of traps, insects captured and numbers of these insects.

The results indicate that the food lure in these trials could be used for behavioral studies of the two species of *Macrodactylus*.

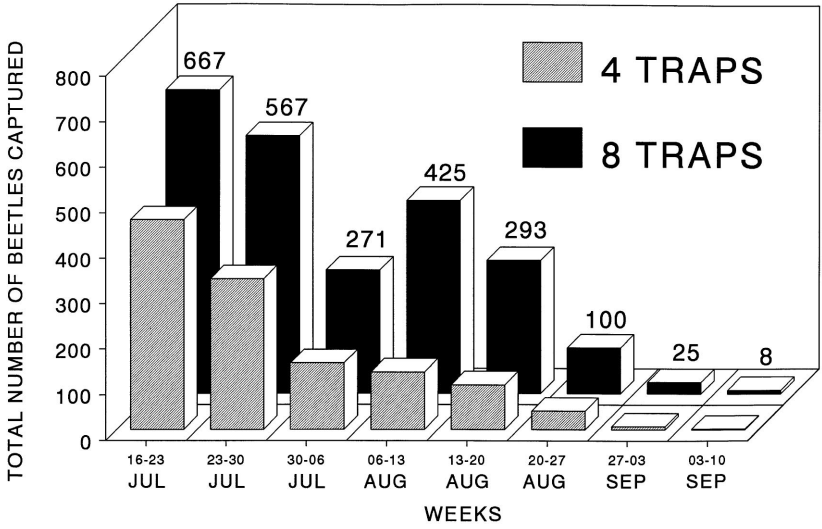

FIG. 3

Fig. 3. Response of *Macrodactylus nigripes* Bates to a food attractant using trap densities of 4 and 8 traps in 1/16 ha, Huamantla, Tlaxcala, Mexico, 1990.

Specimens of other insect groups trapped include a variety of families with diverse feeding habits. Interestingly, the phytophagous insect caught in greatest quantities was another scarab, "mayate de la calabaza," *Euphoria basalis* Burmeister. An average of 0.38 *E. basalis* beetles were collected per week per trap. Cibrián et al. (1990) captured similar numbers of *E. basalis* in Chapingo. Other phytophagous families collected in descending order included Mordellidae, Elateridae, Meloidae, Scarabaeidae (other than *Macrodactylus* and *Euphoria*), Curculionidae, Noctuidae, Nitidulidae, Chrysomelidae, Miridae, Tenebrionidae, Pentatomidae, Lygaeidae, Anthicidae, Cerambycidae, Tephritidae, Cicadellidae, and Coreidae.

Of the insect predators captured, Cleridae were caught in the greatest numbers (0.96 beetles per trap per week). Insects from other predaceous families were captured less frequently (less than 0.107 beetles per trap per week). The major families collected were: Thomisidae, Histeridae, Coccinellidae, Staphylinidae, Carabidae, Lampyridae, Asilidae, Malachiidae, Sphecidae, and Nabidae. Of the pollinating insects, *Apis mellifera* L. was the species which was captured in greatest numbers; the average collected per trap each week was 1.69. Other species of the families Anthophoridae, Colletidae, Megachilidae, Andrenidae and other Apidae were captured less frequently.

Parasitoids were trapped in lesser numbers. Thiphiidae, Ichneumonidae, and Braconidae were all trapped in very small quantities (less than 0.0158 per trap).

Fewer insects were captured in Manantlán, Jalisco, and the trapping was limited to phytophagous, pollinating and predaceous insects. The collections in this zone were generally less than 0.25 insects per trap per fortnight. Of the phytophagous insects captured, *E. basalis* was the most abundant in Manantlán, as well as in Huamantla. Perhaps one of the reasons why insects were captured less frequently than in Huamantla, is that the traps were set out in autumn when populations *M. murinus* were

more abundant than populations of the other insects, thus the total number of organisms decreased.

In general, the effect of the attractants on other insect groups was low indicating that the attractant mixture demonstrated a selectivity in the capture of scarabs, *Macrodactylus* in particular. The most captured insect, other than *Macrodactylus,* was *Apis mellifera;* however, they did not surpass 2 insects per trap per week.

Acknowledgments

Many thanks to Ing. Tonathiu Noyola, Head of the Plant Protection Program of the Secretary of Agriculture and Hydraulic Resources, and the Natural Laboratory, Las Joyas in Jalisco, and to Dr. Bruce Benz for his invaluable collaboration making this investigation possible. Manuscript number 82-94.

References Cited

Alteiri, M. A., and J. Trujillo. 1987. The agroecology of corn production in Tlaxcala, México. Hum. Ecol. 15:189-220.

Carrillo-S., J. L. 1959. Estudios taxonómicos sobre las especies mexicanas del género de *Macrodactylus* Latr. y observaciones biológicas de algunas especies. Tesis Profesional. Escuela Nacional de Agricultura, Chapingo, México.

Cibrian-T., J., H. Arredondo-Bernal, and R. N. Williams. 1990. Evaluación de un atrayente alimenticio para la captura de *Macrodactylus* spp., pp:27-28 *en:* C. B. Landeral, R. Domínguez y J. Sánchez E. [eds.]. Avances de la Investigación 1990. CENA. Colegio de Postgraduados, Montecillo, México.

Fleming, W. E. 1969. Attractants for the Japanese beetle. USDA. Agric. Tech. Bull. 1399. 87 p.

Klein, M. G., and D. C. Edwards. 1989. Captures of *Popillia lewisi* (Coleoptera: Scarabaeidae) and other scarabs on Okinawa with Japanese beetle lures. J. Econ. Entomol. 82(1): 101-103.

Johnson, J. P. 1940. Results of trapping rose chafers. Conn. Agric. Exp. Stn. Bull. (New Haven) 434:314.

Moron, M. A., and R. A. Terron. 1988. Entomología práctica. Instituto de Ecología, A.C. México. pp. 210-243.

Williams, R. N., and K. V. Miller. 1982. Field assay to determine attractiveness of various aromatic compounds to rose chafer adults. J. Econ. Entomol. 75:196-198.

Williams, R. N., T. P. McGovern, M. G. Klein, and D. S. Fickle. 1990. Rose chafer (Coleoptera: Scarabaeidae): improved attractants for adults. J. Econ. Entomol. 83:111-116.